

X-ray Structures of Phospholipids in Bovine Heart Cytochrome c Oxidase

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Cytochrome c oxidase is the terminal oxidase of cell respiration which reduces molecular oxygen to water coupled with proton pumping. The structural and functional investigations of this enzyme have been greatly stimulated by the X-ray structural determinations of the bovine and bacterial enzymes at 1995. However, the composition and conformations of phospholipids have been yet to be determined. Phosphatidylethanolamines(PE), phosphatidylglycerols(PG), phosphatidylcholines(PC) and cardiolipins(CL) were identified in the crystalline bovine heart cytochrome c oxidase preparation by chemical analysis, showing unique fatty acid structures for each phospholipid except PC. All these phospholipids were detectable in the X-ray structure of bovine heart cytochrome c oxidase in the oxidized state at 1.8 Å resolution. The head groups of these phospholipids were located at either one of the surfaces of the transmembrane protein region facing to the protein regions protruding to the aqueous phases. A CL located in the intermembrane side bridged the two monomers in the dimeric structure to stabilize the dimeric state. The temperature factors of the three head groups of phospholipids (2PG and 1PE) as well as their tail portions in subunit III are unusually low as those of the phospholipids found in X-ray structures of proteins determined thus far, suggesting some physiologically important functions of subunit III, such as the O₂ storage.

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